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Metamaterial-inspired Near-field Resonant Parasitic Structure for Directional Suppression of Narrow-band EMI/RFI in Compact Systems

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This paper describes the application of an electrically small, metamaterial-inspired, near-field resonant parasitic (NFRP) element in a nearly space-less design for suppression of narrowband radio-frequency interference (RFI) and its higher-order harmonics. The design of the NFRP structure is inspired by results presented in the existing literature. The possibility of using it as a notch filter as a design integrated in a Printed Circuit Board (PCB) and its advantages over known solutions like electromagnetic bandgap (EBG) or defected ground (DGS) structures are discussed; the results for different orientations are shown. The coupling mechanism of the structure to transmission lines is briefly presented.

To comply with the EMC regulations worldwide is of utmost importance for the diffusion of electronic products. Designers are nowadays facing new issues due to factors like increased clock speed, coexistence of audio and analogue systems, shrinking of PCB dimensions, etc. In most cases, especially for devices where the space is critical as are hand-held terminals or medical implants, there is no room to apply traditional solutions as proper grounding, filtering, and shielding. Furthermore, there is an interest to attenuate a single frequency and its higher-order harmonics: a problem arises when a transmission line needs filtering for a frequency that is very close to the operating frequency.

The filtering effect is here achieved due to the resonant behavior of the NFRP element. The results are obtained by the use of FEM-based simulations. The design of the NFRP element is based on the existing literature, and in particular on the work of Ziolkowski *et al.* The structure is implemented directly in the substrate, in a layer between the signal tracks and the ground (or power) layer. Two orientations of the structure are analyzed, and the importance of the directionality in complex environments is highlighted. An electric-coupled electric-inspired element is shown here and is able to provide narrowband attenuation of a signal travelling on a microstrip line of more than 10 dB for one orientation, while it is 2 dB only when the structure is rotated by 90°.

